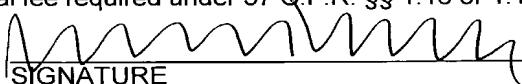


JC13 Rec'd PTO/WFO 05 APR 2002

U.S. APPLICATION NO. <b>107089936</b>		INTERNATIONAL APPLN. NO. PCT/SE00/02014	ATTORNEY DOCKET NO. 1501-1026
21. <input checked="" type="checkbox"/> The following fees are submitted:			CALCULATIONS PTO USE ONLY
<b>BASIC NATIONAL FEE (37 CFR 1.492 (a) (1)-(5):</b>			
Neither international preliminary examination fee nor international search fee paid to USPTO and international Search Report not prepared by the EPO or JPO.....\$1040.00			
International preliminary examination fee not paid to USPTO but International Search Report prepared by the EPO or JPO .....\$890.00			
International preliminary examination fee not paid to USPTO but International search fee paid to USPTO .....\$740.00			
International preliminary examination fee paid to USPTO but all claims did not satisfy provision of PCT Article 33 (1)-(4) .....\$710.00			
International preliminary examination fee paid to USPTO and all claims satisfied provision of PCT Article 33 (1)-(4) .....\$100.00			
<b>ENTER APPROPRIATE BASIC FEE AMOUNT</b>			
\$ 1040.00			
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20- <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e))			
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total Claims	14 - 20 =	0	X \$18.00
Independent Claims	2 - 3 =	0	X \$84.00
MULTIPLE DEPEND CLAIM(S) (if applicable)		+ \$280.00	
<b>TOTAL OF ABOVE CALCULATION -</b> <b>\$ 1040.00</b>			
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.			
+ \$			
<b>SUBTOTAL = \$ 1040.00</b>			
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492Z(f)).			
<b>TOTAL NATIONAL FEE = \$ 1040.00</b>			
Fee for recording the enclosed assigned (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) \$40.00 per property +			
\$ 40.00			
<b>TOTAL FEES ENCLOSED - \$ 1080.00</b>			
Amount to be refunded.			
Charged: \$			
<input checked="" type="checkbox"/> A Check in the amount of <b><u>\$1,080.00</u></b> to cover all fees is attached. <input type="checkbox"/> The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to Deposit account No. 25-0120 in the name of Young & Thompson, as described below. A duplicate copy of this sheet is enclosed. <input checked="" type="checkbox"/> The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fee required under 37 C.F.R. §§ 1.16 or 1.17.			
SEND ALL CORRESPONDENCE TO: 745 South 23 <sup>rd</sup> Street Arlington, VA 22202 Telephone (703) 521-2297 Y&T Customer No. 000466		 <b>SIGNATURE</b> Robert J. Patch <b>NAME</b> 17,355 <b>REGISTRATION NO.</b>	
RJP/bam Date: <b>April 5, 2002</b>			

TRANSMITTAL LETTER OF THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		Attorney Docket No. <u>1501-1026</u> U.S. Application No. <u>10/08993</u>
INTERNATIONAL APPLN. NO. <u>PCT/SE00/02014</u>	INTERNATIONAL FILING DATE <u>18 OCTOBER 2000 (18.10.00)</u>	PRIORITY DATE CLAIMED <u>26 OCTOBER 1999 (26.10.99)</u>
<b>TITLE OF INVENTION: BRAKE DEVICE FOR A CONSTRUCTION MACHINE</b>		
APPLICANT(S) FOR DE/EO/US: <u>BO VIGHOLM</u>		
Applicant herewith submits to the United States Designated Elected Office (DO/EO/US) the following items and other information:		
<ol style="list-style-type: none"> <li><input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</li> <li><input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</li> <li><input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</li> <li><input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</li> <li><input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c)(2))             <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau)</li> <li>b. <input type="checkbox"/> has been communicated by the International Bureau. See attached PCT/IB/308.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ol> </li> <li><input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371 (c)(2))             <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is attached hereto.</li> <li>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</li> </ol> </li> <li><input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))             <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</li> <li>b. <input type="checkbox"/> have been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made, however, the time limit for making such amendments has NOT expired.</li> <li>d. <input type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li><input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).</li> <li><input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li> <li><input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol> <p><b>Items 11 to 20 below concern document(s) or information included:</b></p> <ol style="list-style-type: none"> <li>11. <input checked="" type="checkbox"/> Information Disclosure Statement (IDS) w/PTO-1449 - <input checked="" type="checkbox"/> Copy of IDS citations</li> <li>12. <input checked="" type="checkbox"/> Assignment Papers (cover sheet &amp; document(s))</li> <li>13. <input checked="" type="checkbox"/> A FIRST Preliminary Amendment.</li> <li>14. <input type="checkbox"/> A SECOND or SUBSEQUENT Preliminary Amendment.</li> <li>15. <input type="checkbox"/> A substitute specification.</li> <li>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule</li> <li>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</li> <li>19. <input type="checkbox"/> A second copy of the English language translation of the international application (35 U.S.C. 154(d)(4)).</li> <li>20. <input checked="" type="checkbox"/> Other items or information: <u>INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT/IPEA/409)</u>, <u>INTERNATIONAL SEARCH REPORT (PCT/ISA/210)</u>, <u>APPLICATION DATA SHEET</u>, <u>ABSTRACT</u></li> </ol>		

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JC13 Rec'd PCT/PTO 05 APR 2002

PATENT  
1501-1026

**IN THE U.S. PATENT AND TRADEMARK OFFICE**

In re application of: Bo VIGHOLM

Appl. No.: **NEW NATIONAL PHASE  
APPLICATION IN THE  
UNITED STATES**

Group:

Filed: April 5, 2002

Examiner:

For: BRAKE DEVICE FOR A CONSTRUCTION MACHINE

**PRELIMINARY AMENDMENT**

Assistant Commissioner for Patents  
Washington, DC 20231

April 5, 2002

Sir:

Prior to the first Official Action and calculation of the filing fee, the following preliminary amendments and remarks are respectfully submitted in connection with the above-identified application.

**IN THE ABSTRACT OF THE DISCLOSURE:**

Delete the abstract as originally filed which appears on the cover sheet of the Published Application. Add new Abstract as enclosed herewith on a separate sheet.

**IN THE CLAIMS:**

Please substitute claims 1-9 originally filed, which appear on pages 9-10 with claims 1-12 as filed in the Article 34.

amendment of April 9, 2001. The pages containing claims 1-12 are marked "AMENDED SHEET" and are attached hereto. Following the insertion of claims 1-12, please amend the claims as follows:

Please amend the claims as follows:

--3. (Amended) Brake device according to Claim 1, **characterized in that** the limiting element comprises a restrictor valve (42'), which limits the flow of hydraulic oil.

4. (Amended) Brake device according to Claim 2, **characterized in that** a first bypass line (22) is connected over the limiting element (18, 42') so that hydraulic oil is allowed to bypass the limiting element (18, 42') and that a non-return valve (24) is arranged in the first bypass line (22), so that hydraulic oil is prevented from flowing through the first bypass line (22) in the direction towards the brake member (4, 10).

11. (Amended) Method according to Claim 9  
**characterized in**  
that the second brake member (10) is essentially continuously activated until said predetermined pressure is reached.

12. (Amended) Method according to Claim 9,  
**characterized in**

that a pressure controlled valve (18) in the brake circuit to the second brake member (10) is opened when said predetermined pressure is reached.--

Please add the following claims:

--13. (New) Brake device according to Claim 2, **characterized in that** the limiting element comprises a restrictor valve (42'), which limits the flow of hydraulic oil.--

--14. (New) Brake device according to Claim 13, **characterized in that** a first bypass line (22) is connected over the limiting element (18, 42') so that hydraulic oil is allowed to bypass the limiting element (18, 42') and that a non-return valve (24) is arranged in the first bypass line (22), so that hydraulic oil is prevented from flowing through the first bypass line (22) in the direction towards the brake member (4, 10).--

REMARKS

Claims 13-14 have been added. Claims 3-4 and 11-12 have been amended to eliminate multiple dependencies.

The substitution of claims 1-12 has been done to merely place this national phase application in into the same condition as it was during Chapter II of the International Phase.

Entry of the above amendments is earnestly solicited. An early and favorable first action on the merits is earnestly requested.

Should there be any matters that need to be resolved in the present application, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

Attached hereto is a marked-up version of the changes made to the claims and Abstract by the current amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

YOUNG & THOMPSON



Robert J. Patch, Reg. 17,355  
745 South 23<sup>rd</sup> Street  
Arlington, VA 22202  
Telephone (703) 521-2297

RJP/bam  
Attachments

VERSION WITH MARKINGS TO SHOW CHANGES MADEIN THE ABSTRACT OF THE DISCLOSURE:

The Abstract of the Disclosure has been amended as follows:

**Abstract**

The invention relates to a brake device(1) for a construction machine, ~~comprising~~includes a first brake circuit (2), which is coupled to a first brake member(4) on a first wheel axle(6) of the machine, a second brake circuit—(8), which is coupled to a second brake member(10) on a second wheel axle(12) of the machine, the first and second brake circuits(2, 8) being independent of one another, a pressure source(14) for hydraulic oil, which is coupled to the first and second brake circuit—(2, 8), and a brake valve—(16, 16'), which is coupled to the first and second brake circuit (2, 8), which brake valve(16, 16') is designed to control the hydraulic oil from the pressure source(14) to the brake members(4, 10) on the wheel axles—(6, 12). The first or second brake circuit (2, 8) ~~comprises~~includes limiting elements—(18, 42'), which limit the pressure and/or flow of hydraulic oil when the brake valve(16, 16') controls the hydraulic oil from the pressure source(14) to the brake members(4, 10) on the wheel axles—(6, 12).

IN THE CLAIMS:

The claims have been amended as follows:

3. (Amended) Brake device according to either of Claims 1 and 2, Claim 1, characterized in that the limiting element comprises a restrictor valve (42'), which limits the flow of hydraulic oil.

4. (Amended) Brake device according to either of Claims 2 and 3, Claim 2, characterized in that a first bypass line (22) is connected over the limiting element (18, 42') so that hydraulic oil is allowed to bypass the limiting element (18, 42') and that a non-return valve (24) is arranged in the first bypass line (22), so that hydraulic oil is prevented from flowing through the first bypass line (22) in the direction towards the brake member (4, 10).

11. (Amended) Method according to any of Claim 9-10  
**characterized in**  
that the second brake member (10) is essentially continuously activated until said predetermined pressure is reached.

12. (Amended) Method according to any of Claim 9-11,  
**characterized in**  
that a pressure controlled valve (18) in the brake circuit to the second brake member (10) is opened when said predetermined pressure is reached.

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INDEXED  
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09 April

- 9 -

Claims

1. Brake device for a construction machine, comprising a first brake circuit (2), which is coupled to a first brake member (4) on a first wheel axle (6) of the machine, a second brake circuit (8), which is coupled to a second brake member (10) on a second wheel axle (12) of the machine, the first and second brake circuits (2, 8) being independent of one another, a pressure source (14) for hydraulic oil, which is coupled to the first and second brake circuit (2, 8), a brake valve (16, 16'), which is coupled to the first and second brake circuit (2, 8),, which brake valve (16, 16') is designed to control the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12), and a brake pedal (30) coupled to the brake valve (16, 16') arranged so as to control the brake valve (16, 16') **characterized by** a limiting element (18, 36, 42') arranged in the first or second brake circuit (2, 8), which element limits the pressure and/or flow of hydraulic oil when the brake valve (16, 16') controls the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12), and that the limiting element (18, 36, 42') is adapted to limit the flow to the brake member (10) in the brake circuit (8) of the limiting element (18, 36, 42') up to a predetermined hydraulic oil pressure and to open for a through flow of hydraulic oil, when the predetermined pressure is reached to achieve a delayed activation of the brake member (10) in the brake circuit of the limiting element (18, 36, 42').

30

2. Brake device according to Claim 1, **characterized in that** the limiting element comprises a sequence valve (18), which opens when the hydraulic oil pressure reaches a predetermined pressure.

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PC 82 00/2014  
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- 10 -

3. Brake device according to either of Claims 1 and 2, **characterized in that** the limiting element comprises a restrictor valve (42'), which limits the flow of hydraulic oil.

5  
10 4. Brake device according to either of Claims 2 and 3, **characterized in that** a first bypass line (22) is connected over the limiting element (18, 42') so that hydraulic oil is allowed to bypass the limiting element (18, 42') and that a non-return valve (24) is arranged in the first bypass line (22), so that hydraulic oil is prevented from flowing through the first bypass line (22) in the direction towards the brake member (4, 10).

15 5. Brake device according to Claim 2, **characterized in that** a second bypass line (40) is connected over the sequence valve (18) and that a restrictor valve (42) is arranged in the second bypass line (40), so that a limited flow of hydraulic oil can bypass the sequence valve (18).

20 6. Brake device according to Claim 1, **characterized in that** the brake valve (16') comprises the said limiting element (36).

25 7. Brake device according to Claim 6, **characterized in that** the brake valve (16') comprises a first slide (32), which controls the flow of hydraulic oil in the first brake circuit (2), and a second slide (34), which controls the flow of hydraulic oil in the second brake circuit (8), which 30 first slide (32) is arranged so as to control the second slide (34), so that the second slide (34) opens the second brake circuit (8) when the pressure in the first brake circuit (2) has reached a predetermined pressure.

09 Apr 01

- 11 -

8. Brake device according to Claim 7, **characterized in**  
**that** the limiting element comprises a first spring (36),  
which acts on the second slide (34)

5 9. Method of braking a construction machine comprising a  
brake device provided with a first brake circuit (2), which  
is coupled to a first brake member (4) on a first wheel axle  
(6) of the machine, and a second brake circuit (8), which is  
coupled to a second brake member (10) on a second wheel axle  
(12) of the machine,

**characterized in**

that the first brake member (4) is activated when depressing  
the brake pedal only a short way, and that the second brake  
member (10) is essentially activated with delayed effect.

15 10. Method according to Claim 9,  
**characterized in**

that the hydraulic oil pressure to the second brake member  
(10) is limited until a predetermined hydraulic oil pressure  
20 to the first brake member (4) is reached, and that the  
second brake member (10) is essentially activated when said  
predetermined hydraulic oil pressure to the first brake  
member (4) is reached.

25 11. Method according to any of Claim 9-10  
**characterized in**

that the second brake member (10) is essentially  
continuously activated until said predetermined pressure is  
reached.

30 12. Method according to any of Claim 9-11,  
**characterized in**

that a pressure controlled valve (18) in the brake circuit  
to the second brake member (10) is opened when said  
35 predetermined pressure is reached.

## Abstract

A brake device for a construction machine, includes a first brake circuit, which is coupled to a first brake member on a first wheel axle of the machine, a second brake circuit, which is coupled to a second brake member on a second wheel axle of the machine, the first and second brake circuits being independent of one another, a pressure source for hydraulic oil, which is coupled to the first and second brake circuit, and a brake valve, which is coupled to the first and second brake circuit, which brake valve is designed to control the hydraulic oil from the pressure source to the brake members on the wheel axles. The first or second brake circuit includes limiting elements, which limit the pressure and/or flow of hydraulic oil when the brake valve controls the hydraulic oil from the pressure source to the brake members on the wheel axles.

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3 | PYD

- 1 -

Brake device for a construction machine

The present invention relates to a brake device for a construction machine, comprising a first brake circuit, which is coupled to a first brake member on a first wheel axle of the machine, a second brake circuit, which is coupled to a second brake member on a second wheel axle of the machine, the said first and second brake circuits being independent of one another, a pressure source for hydraulic oil, which is coupled to the first and second brake circuit, and a brake valve, which is coupled to the first and second brake circuit, the brake valve being designed to control the hydraulic oil from the pressure source to the brake members on the wheel axles.

A construction machine, such as a wheeled loader or a dumper truck, must be equipped with brakes that are suited to the varying characteristics of the machine. In one extreme case a fully loaded machine must be powerfully retarded and in another extreme case the same machine without a load must be gently braked. In order to enable the driver of the machine to handle the machine, the retardation of the machine must feel controllable and manageable under all operating conditions. From an ergonomic standpoint, the force applied to the brake pedal by the driver must be the minimum possible. The control travel of the brake pedal must also be the minimum possible.

The brake systems hitherto fitted on construction machines comprise two or more independent brake circuits, which are controlled by a brake valve. The brake valve is coupled to the brake pedal, which opens the valve when a force is applied by the driver, so that hydraulic oil under pressure flows to brake members, which are arranged on machine wheel axles or wheels. The brake members comprise a piston, which is moved under the pressure of the hydraulic oil and presses a brake lining 7 against a brake disc. When the driver releases the brake pedal the pressure on the

- 2 -

brake piston 5 ceases and the brake lining 7 is moved into an initial position by means of return springs.

When the driver presses the brake pedal, thereby opening the brake valve, it takes a certain time to move the 5 brake piston 5 from the initial position to the position assumed by the brake piston 5 when the brake lining is bearing against the brake disc. This time is called the brake application time. Once the brake piston has reached this latter position the pressurization of the hydraulic oil 10 against the brake piston commences, which leads to a powerful excess pressure surge in the form of a pressure pulse in the hydraulic oil. This excess pressure surge gives rise to a brake shock, that is to say a powerful retardation of the machine in a short time, which the driver 15 experiences as a jerk. The excess pressure surge also results in components of the brake members being exposed to heavy stresses, which among other things generates noise. The jerking and the noise are experienced by the driver of the machine as irritations.

20 In gentle braking the force on the brake pedal must be slight. If the machine is travelling on an uneven surface, so that the machine jumps and shakes, it becomes difficult for the driver to control the brake device by means of the brake pedal in order to achieve gentle braking. 25 The retardation of the machine will then vary, so that the driver perceives the brake device as difficult to control. In order to achieve good controllability of the brake device, the brake application time must be as short as possible and the excess pressure surge as small as possible. 30 A short brake application time is achieved by means of a large flow of hydraulic oil through the brake valve, but the greater the flow of hydraulic oil, the greater the excess pressure surge becomes.

An object of the present invention is to produce a 35 brake device, which is adapted to the various operating

- 3 -

conditions of a construction machine, so that machine jerking and noise are avoided when braking the machine.

Another object of the invention is to produce a brake device that exhibits little sensitivity in gentle  
5 braking.

This is achieved by a brake device of the type specified in the introductory part, in which a limiting element arranged in the first or second brake circuit limits the pressure and/or flow of the hydraulic oil when the brake  
10 valve is controlling the hydraulic oil from the pressure source to the brake members on the wheel axles.

The limiting element helps to reduce the braking action on the one wheel axle at the commencement of the braking sequence, which thereby reduces the sensitivity of  
15 the brake device. When the driver depresses the brake pedal gently in order to brake gently, only a small flow of hydraulic oil, if any, will occur in the brake circuit that is fitted with the limiting element, while a large flow of hydraulic oil will flow in the brake circuit that is not  
20 fitted with a limiting element. Once a certain time has elapsed or once the hydraulic oil pressure has reached a predetermined limit, the pressure applied to the brake member on the wheel axle that had reduced braking action from the outset will increase the braking action on that  
25 wheel axle. In the event of emergency-stop braking, for example, all wheel axles of the vehicle will be braked immediately when the driver presses the brake pedal.

The invention will be explained in more detail below with the aid of embodiments shown in the figures attached,  
30 in which

Fig. 1 shows the hydraulic pressure as a function of the time taken to activate a known brake device,

35 Fig. 2 shows a first embodiment of a brake device according to the present invention,

- 4 -

Fig. 3 shows a brake valve for the brake device according to the present invention,

5 Fig. 4 shows a second embodiment of a brake device according to the present invention,

Fig. 5 shows a third embodiment of a brake device according to the present invention,

10 Fig. 6 shows a fourth embodiment of a brake device according to the present invention.

Figure 1 contains a graph showing how the hydraulic pressure varies when a known brake device is activated. The horizontal axis gives the time T and the vertical axis gives the pressure P. As stated in the introductory part of the specification, it takes a certain time  $t_1$  to move a brake piston from an initial position to a position assumed by the 15 brake piston when a brake lining, against which the brake piston presses, is bearing against a brake disc. When the brake piston is in this latter position the pressurization of the hydraulic oil against the brake piston commences, which leads to a powerful excess pressure surge in the form 20 of a pressure pulse in the hydraulic oil. This pressurization takes place over a period of time  $t_2$ . The excess pressure surge gives rise to a brake shock, that is to say a powerful retardation of the machine in a short time, which the driver experiences as a jerk. It has also 25 emerged that noise is generated in the brake device as a result of the said excess pressure surge.

Figure 2 shows a first embodiment of a brake device 1 according to the present invention. The brake device 1 comprises a first brake circuit 2, which is coupled to a 30 first brake member 4 on a first wheel axle 6 of a construction machine. The brake member 4 comprises a brake

- 5 -

piston 5 fitted to each wheel, which piston by way of one or more brake linings 7 interacts with a brake disc (not shown) connected to the wheel axle 6. The brake device 1 also comprises a second brake circuit 8, which is coupled to a 5 second brake member 10 on a second wheel axle 12 of the machine. After application of the brake device the first and second brake circuits 2, 8 are independent of one another, which means that the pressure in one circuit 2, 8 does not affect the hydraulic oil pressure in the other 10 circuit 2, 8. If one circuit 2, 8 fails, the construction machine can still be braked by means of the other circuit 2, 8. A pressure source 14 for hydraulic oil is coupled to the first and second brake circuit 2, 8. The pressure source 14 may take the form, for example, of a hydraulic pump and/or 15 one or more hydraulic accumulators (not shown). A brake valve 16 is coupled to the first and second brake circuit 2, 8, which brake valve 16 is designed to control the hydraulic oil from the pressure source 14 to the brake members 4, 10 on the wheel axles 6, 12. A limiting element in the form of 20 a sequence valve 18 is arranged in the second brake circuit 8.

When the brake valve 16 controls the hydraulic oil from the pressure source 14 to the brake members 4, 10 on the wheel axles 6, 12, the sequence valve 18 will limit the 25 hydraulic oil flow to the second brake member 10 if the pressure of the hydraulic oil falls below a predetermined pressure. This limiting may mean that little hydraulic oil, if any, flows through the sequence valve 18. The sequence valve 18 opens when the hydraulic oil pressure reaches a 30 predetermined pressure, so that a large hydraulic oil flow through the sequence valve 18 occurs. The function of the sequence valve 18 can thus be likened to the function of a pressure-relief valve.

When the brake device 1 is activated, the hydraulic 35 oil in the brake members 4, 10 will be drained, which means that the hydraulic oil will flow in the direction away from

- 6 -

the brake members 4, 10 to the brake valve 16 and on to a tank 20. In order to achieve this, a first bypass line 22 is connected over the sequence valve 18, so that hydraulic oil is allowed to bypass the sequence valve 18. A non-return valve 24 is arranged in the first bypass line 22, so that hydraulic oil is prevented from flowing through the first bypass line 22 in the direction towards the second brake member 10.

According to a first embodiment the brake valve 16 comprises a first and second valve 26, 28, which are acted upon by a brake pedal 30. When the brake pedal 30 is depressed, the first and second slide valves 26, 28 are opened, so that hydraulic oil flows from the pressure source 14 towards the first and second brake members 4, 10. It is preferably the pressure in the first brake circuit 2 that influences the opening of the second slide valve 28, which is indicated by a duct 29 between the first brake circuit 2 and the second slide valve 28.

Alternatively, the first and second slide valves 26, 28 together with the sequence valve 18 and the first bypass line 22 with the non-return valve 24 may be replaced by a brake valve 16', as shown in figure 3. The said brake valve 16' comprises a first slide 32, which controls the flow of hydraulic oil in the first brake circuit 2, and a second slide 34, which controls the flow of hydraulic oil in the second brake circuit 8. The first slide 32 is arranged so as to control the second slide 34, so that the second slide 34 opens the second brake circuit 8 when the pressure in the first brake circuit 2 has reached a predetermined pressure. The said predetermined pressure is determined by the spring force of a first spring 36 of the brake valve 16'. The first slide 32 is connected to the brake pedal 30 and when the brake pedal 30 is depressed, the first slide 32 will be displaced in the brake valve 16', so that the first brake circuit 2 is opened. A second spring 38, arranged between the first and second slide 32, 34, ensures that the second

- 7 -

slide 34 is not displaced by the first slide 32 from the outset. When the first slide 32 has been displaced so far that the first circuit 2 has been opened, the hydraulic oil in the first branch line 33 to the circuit 2 will pressurize 5 the space between the slides 32, 34. When the pressure in the first circuit 2 overcomes the force of the first spring 36, which acts on the second slide 34, the second slide 34 will open the second circuit 8. A second branch line 35 in the second circuit 8 carries hydraulic oil to the end of the 10 second slide 34, which faces the first spring 36. When the pressure in the second circuit 8 together with the force from the first spring 36 overcome the pressure in the first circuit 2, the second slide 34 will close the second circuit 8. The pressure in the second circuit 8 will thereby become 15 lower than the pressure in the first circuit 2. The difference between the pressure in the first and second circuit 2, 8 depends upon the magnitude of the spring force of the first spring 36. The first spring 36 will thereby function as a limiting element.

20 If the brake pedal 30 is only depressed a short way, in order to undertake gentle braking, only the first wheel axle 6 will be braked. When braking harder, the force of the first spring 36 must be overcome, so that both of the brake circuits 2, 8 are opened, which means that both of the 25 wheel axles 6, 12 are braked. If one of the circuits 2, 8 should fail and hydraulic pressure in one of the circuits 2, 8 be absent when the brake device 1 is applied, the brake pedal 30 can be depressed to such a degree that the second spring 38 is compressed, which means that the second slide 34 will also be displaced, so that the second brake circuit 30 8 is opened.

Figure 4 shows a second embodiment of the invention. In this embodiment a second bypass line 40 is arranged over the sequence valve 18. A restrictor valve 42, which means 35 that a limited flow of hydraulic oil can always bypass the sequence valve 18, is arranged in the second bypass line 40.

- 8 -

By means of the limited hydraulic oil flow, the second brake member 10 will be slowly activated and will brake the second wheel axle 12 by gentle braking when the pressure of the hydraulic oil does not attain the predetermined pressure at 5 which the sequence valve 18 opens. Retarded braking of the second wheel axle 12 is therefore achieved.

According to a third embodiment, which is shown in figure 5, it is feasible to provide only the second brake circuit 8 with a restrictor valve 42', so that retarded 10 braking of the second wheel axle 12 occurs. The restrictor valve 42' here constitutes a limiting element. In this way brake shock is prevented in gentle braking of the machine. It is also feasible, according to a fourth embodiment in figure 6, to arrange the first bypass line 22 with a non- 15 return valve 24 over the restrictor valve 42' in the second brake circuit 8. This achieves rapid draining of the second brake member 10 when the brake device 1 is deactivated.

A brake device 1 with two brake circuits 2, 8 has been described above. It is possible, however, to design the 20 brake device 1 with three or more brake circuits. It is also possible to arrange the limiting element 18, 42' in the first brake circuit 2 rather than the second brake circuit 8. The first wheel axle 6 may be a front axle and the second wheel axle 12 may be a rear axle of the machine, or 25 vice versa.

09 April.

- 9 -

**Claims**

1. Brake device for a construction machine, comprising a first brake circuit (2), which is coupled to a first brake member (4) on a first wheel axle (6) of the machine, a second brake circuit (8), which is coupled to a second brake member (10) on a second wheel axle (12) of the machine, the first and second brake circuits (2, 8) being independent of one another, a pressure source (14) for hydraulic oil, which is coupled to the first and second brake circuit (2, 8), a brake valve (16, 16'), which is coupled to the first and second brake circuit (2, 8),, which brake valve (16, 16') is designed to control the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12), and a brake pedal (30) coupled to the brake valve (16, 16') arranged so as to control the brake valve (16, 16') **characterized by** a limiting element (18, 36, 42') arranged in the first or second brake circuit (2, 8), which element limits the pressure and/or flow of hydraulic oil when the brake valve (16, 16') controls the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12), and that the limiting element (18, 36, 42') is adapted to limit the flow to the brake member (10) in the brake circuit (8) of the limiting element (18, 36, 42') up to a predetermined hydraulic oil pressure and to open for a through flow of hydraulic oil, when the predetermined pressure is reached to achieve a delayed activation of the brake member (10) in the brake circuit of the limiting element (18, 36, 42').

30

2. Brake device according to Claim 1, **characterized in that** the limiting element comprises a sequence valve (18), which opens when the hydraulic oil pressure reaches a predetermined pressure.

35

- 10 -

3. Brake device according to either of Claims 1 and 2, **characterized in that** the limiting element comprises a restrictor valve (42'), which limits the flow of hydraulic oil.

5

4. Brake device according to either of Claims 2 and 3, **characterized in that** a first bypass line (22) is connected over the limiting element (18, 42') so that hydraulic oil is allowed to bypass the limiting element (18, 42') and that a non-return valve (24) is arranged in the first bypass line (22), so that hydraulic oil is prevented from flowing through the first bypass line (22) in the direction towards the brake member (4, 10).

10

5. Brake device according to Claim 2, **characterized in that** a second bypass line (40) is connected over the sequence valve (18) and that a restrictor valve (42) is arranged in the second bypass line (40), so that a limited flow of hydraulic oil can bypass the sequence valve (18).

20

6. Brake device according to Claim 1, **characterized in that** the brake valve (16') comprises the said limiting element (36).

25

7. Brake device according to Claim 6, **characterized in that** the brake valve (16') comprises a first slide (32), which controls the flow of hydraulic oil in the first brake circuit (2), and a second slide (34), which controls the flow of hydraulic oil in the second brake circuit (8), which first slide (32) is arranged so as to control the second slide (34), so that the second slide (34) opens the second brake circuit (8) when the pressure in the first brake circuit (2) has reached a predetermined pressure.

09 Apr 01

8. Brake device according to Claim 7, **characterized in**  
**that** the limiting element comprises a first spring (36),  
which acts on the second slide (34)

5 9. Method of braking a construction machine comprising a  
brake device provided with a first brake circuit (2), which  
is coupled to a first brake member (4) on a first wheel axle  
(6) of the machine, and a second brake circuit (8), which is  
coupled to a second brake member (10) on a second wheel axle  
10 (12) of the machine,

**characterized in**  
that the first brake member (4) is activated when depressing  
the brake pedal only a short way, and that the second brake  
member (10) is essentially activated with delayed effect.

15 10. Method according to Claim 9,  
**characterized in**

that the hydraulic oil pressure to the second brake member  
(10) is limited until a predetermined hydraulic oil pressure  
20 to the first brake member (4) is reached, and that the  
second brake member (10) is essentially activated when said  
predetermined hydraulic oil pressure to the first brake  
member (4) is reached.

25 11. Method according to any of Claim 9-10

**characterized in**  
that the second brake member (10) is essentially  
continuously activated until said predetermined pressure is  
reached.

30 12. Method according to any of Claim 9-11,  
**characterized in**

that a pressure controlled valve (18) in the brake circuit  
to the second brake member (10) is opened when said  
35 predetermined pressure is reached.

18/9  
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**(54) Title:** BRAKE DEVICE FOR A CONSTRUCTION MACHINE

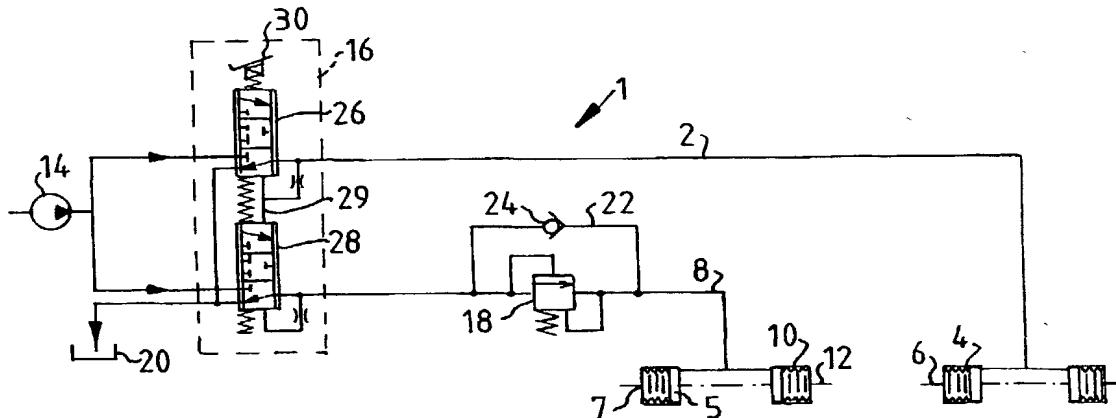
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**(57) Abstract:** The invention relates to a brake device (1) for a construction machine, comprising a first brake circuit (2), which is coupled to a first brake member (4) on a first wheel axle (6) of the machine, a second brake circuit (8), which is coupled to a second brake member (10) on a second wheel axle (12) of the machine, the first and second brake circuits (2, 8) being independent of one another, a pressure source (14) for hydraulic oil, which is coupled to the first and second brake circuit (2, 8), and a brake valve (16, 16'), which is coupled to the first and second brake circuit (2, 8), which brake valve (16, 16') is designed to control the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12). The first or second brake circuit (2, 8) comprises limiting elements (18, 42'), which limit the pressure and/or flow of hydraulic oil when the brake valve (16, 16') controls the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12).

1/3

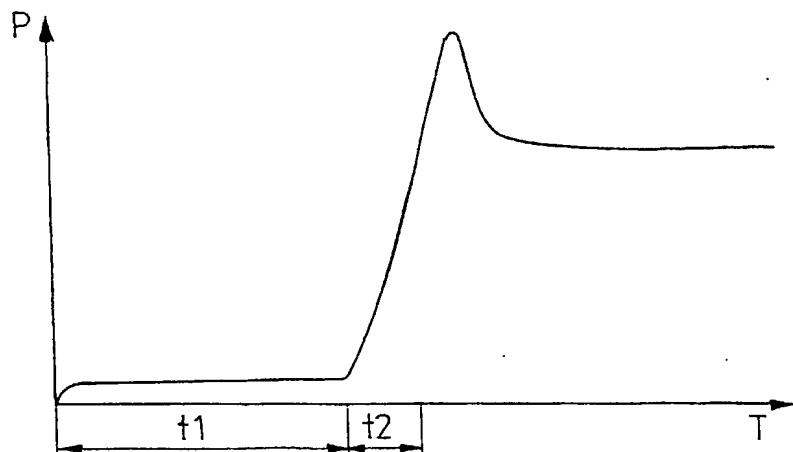


FIG.1

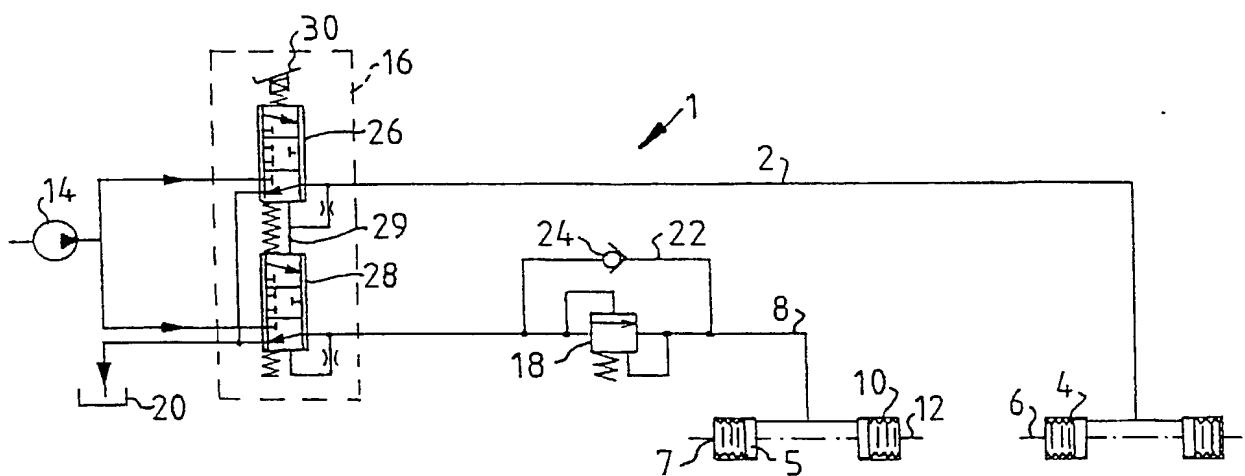


FIG.2

2 / 3

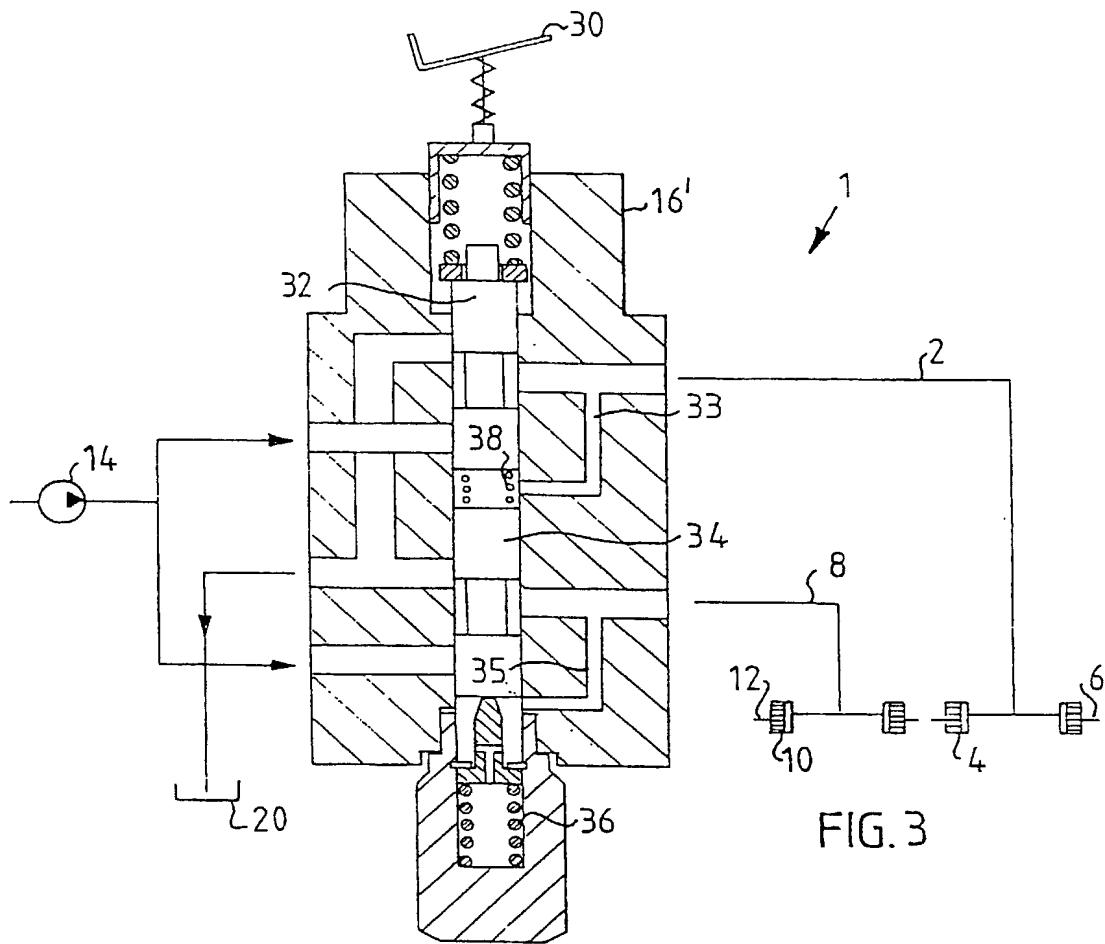


FIG. 3

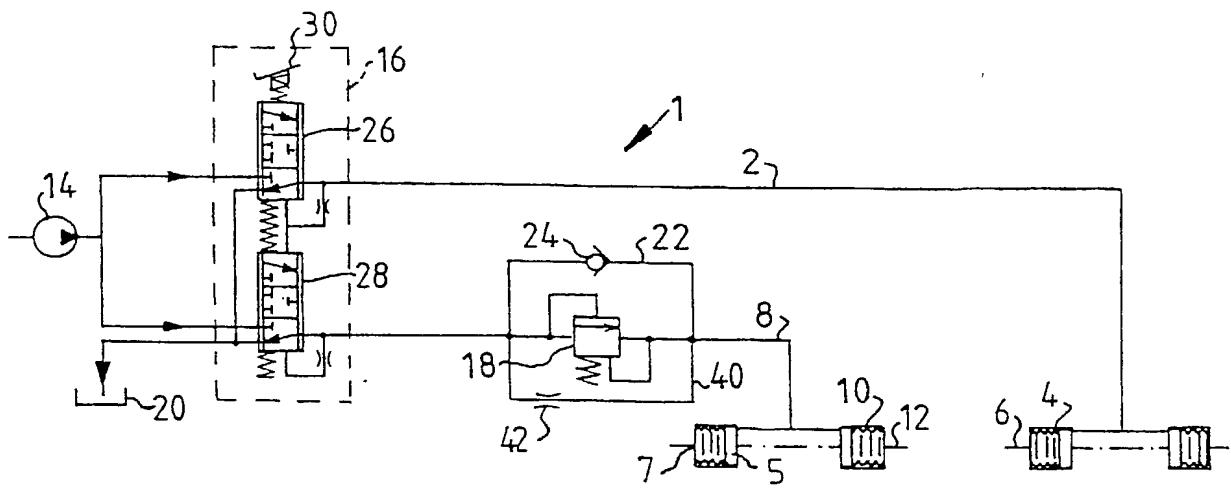


FIG. 4

3 / 3

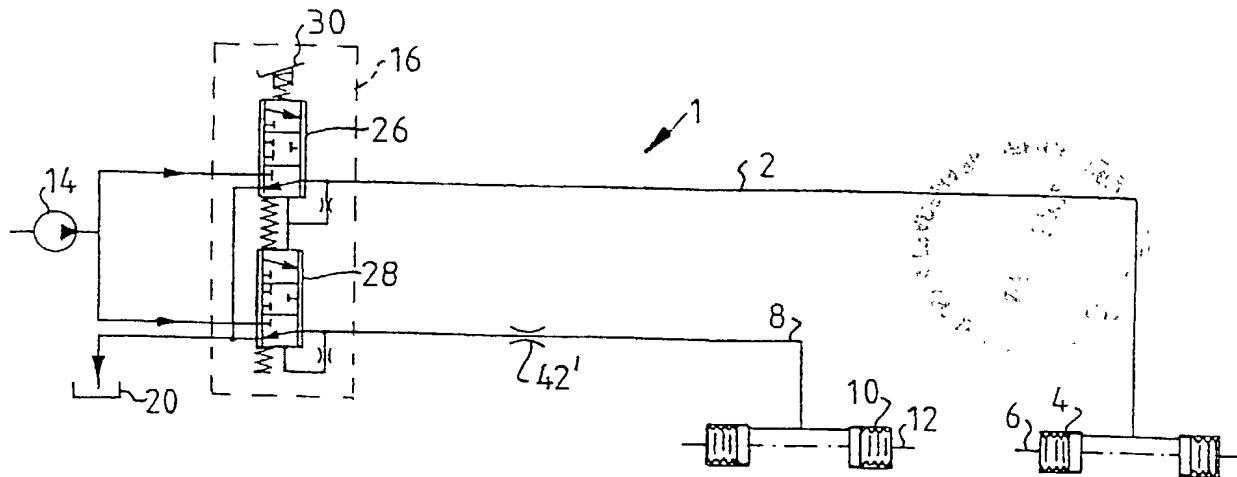


FIG. 5

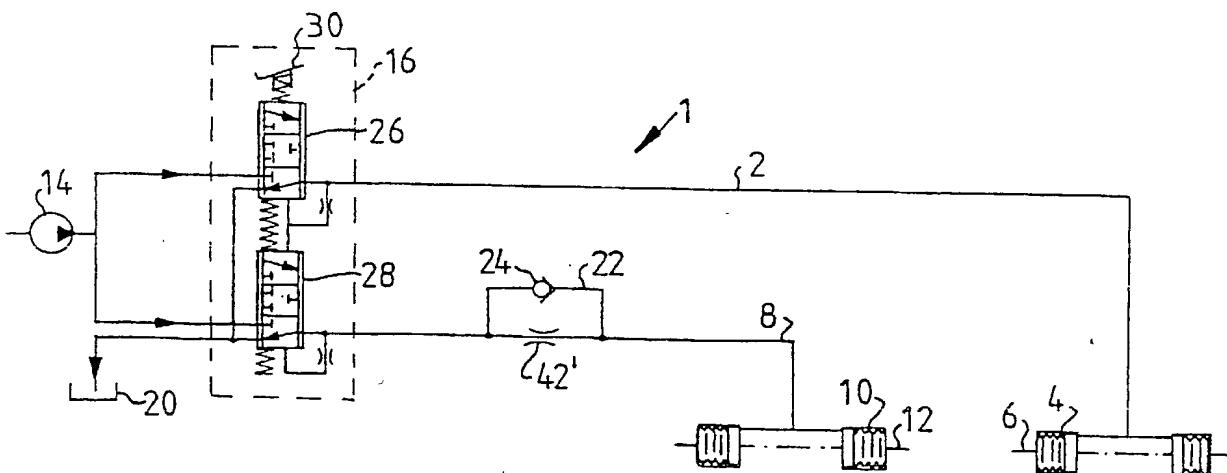


FIG. 6

## COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

BRAKE DEVICE FOR A CONSTRUCTION MACHINE

the specification of which: *(check one)*

### REGULAR OR DESIGN APPLICATION

is attached hereto.

was filed on \_\_\_\_\_ as application Serial No. \_\_\_\_\_  
and was amended on \_\_\_\_\_ (if applicable).

### PCT FILED APPLICATION ENTERING NATIONAL STAGE

was described and claimed in International application No.  
PCT/SE00/02014 filed on 18 October 2000  
and as amended on \_\_\_\_\_ (if any).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

### PRIORITY CLAIM

I hereby claim foreign priority benefits under 35 USC 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

### PRIOR FOREIGN APPLICATION(S)

Country	Application Number	Date of Filing (day, month, year)	Priority Claimed
Sweden	9903856-4	26 October 1999	Yes

*(Complete this part only if this is a continuing application.)*

I hereby claim the benefit under 35 USC 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Code of Federal Regulations §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

## POWER OF ATTORNEY

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As a named inventor, I hereby appoint the following attorney(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Robert J. PATCH, Reg. No. 17,355, Andrew J. PATCH, Reg. No. 32,925, Robert F. HARGEST, Reg. No. 25,590, Benoit CASTEL, Reg. No. 35,041, Eric JENSEN, Reg. No. 37,855, Thomas W. PERKINS, Reg. No. 33,027, and Roland E. LONG, Jr., Reg. No. 41,949, c/o YOUNG & THOMPSON, Second Floor, 745 South 23rd Street, Arlington, Virginia 22202.

Address all telephone calls to Young & Thompson at 703/521-2297. 7

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's signature \_\_\_\_\_ Date \_\_\_\_\_

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Citizenship:

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(given name, family name)

Inventor's signature \_\_\_\_\_ Date \_\_\_\_\_

Residence:

Citizenship:

Post Office Address: